

RadCalNet: A prototype radiometric calibration network for Earth observing imagers

Brian N. Wenny¹, Marc Bouvet², Kurtis Thome³, Jeffrey Czapla-Myers⁴, Nigel Fox⁵, Philippe Goryl⁶, Patrice Henry⁷, Aimé Meygret⁷, Chuanrong Li⁸, Lingling Ma⁸, Lingli Tang⁸ and Emma Woolliams⁵

¹Science Systems & Applications, Inc., Lanham, MD, USA

²Chair of the RadCalNet Working Group, European Space Agency (ESA)

³NASA Goddard Space Flight Center, Greenbelt, MD, USA

⁴College of Optical Sciences, University of Arizona, Tucson, AZ, USA

⁵National Physical Laboratory (NPL), Teddington, UK

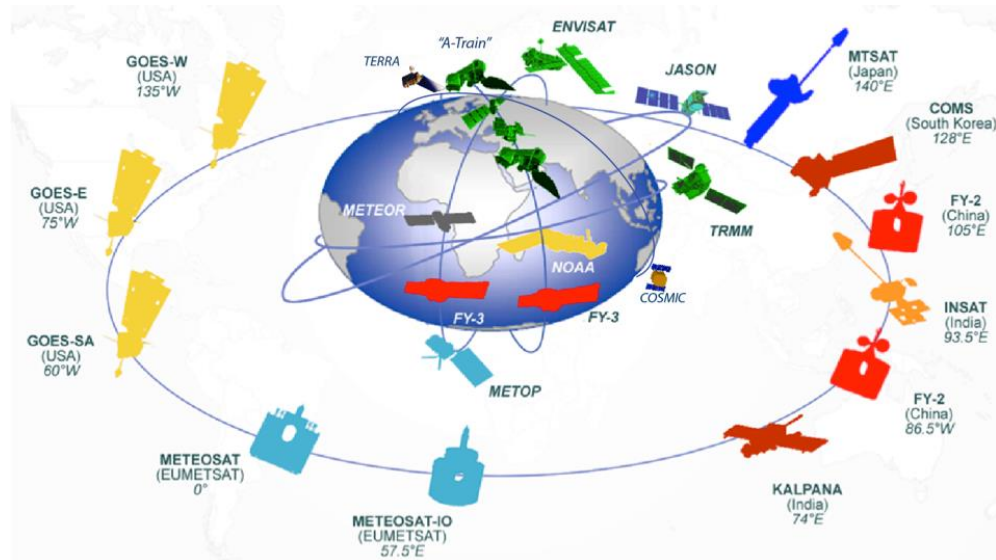
⁶European Space Agency (ESA), European Space Research Institute (ESRIN), Frascati, Italy

⁷Centre National d'Etudes Spatiales (CNES), Toulouse, France

⁸Academy of Opto-Electronics (AOE), Chinese Academy of Sciences (CAS), Beijing, China

Motivation

- The increasing number of Earth observing satellite sensors creates a challenge to ensure a consistent and harmonized absolute radiometric calibration to the same SI-traceable scale.
- On-orbit calibration approaches vary by sensor, operating agency and available resources.



Motivation



WGCV — Working Group on Calibration and Validation

IVOS — Infrared and Visible Optical Sensors

RadCalNet

- CEOS-WGCV-IVOS established a working group to coordinate a network for radiometric calibration using member provided resources.
 - Standardize methodology and data processing streams

Motivation

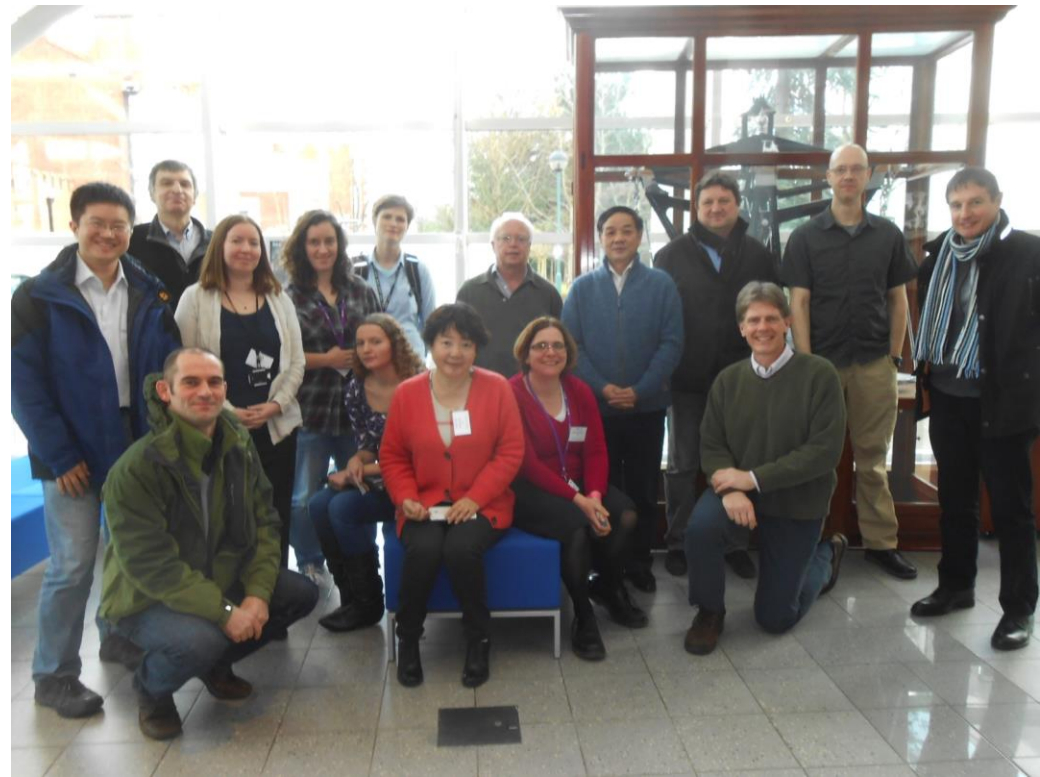
- Field campaigns for sensor vicarious calibration and validation can be burdensome, time-consuming and agency resource-consuming
- RadCalNet will use automated in-situ systems to increase number of potential sensor match-ups
 - Reduce overall uncertainty
 - Traceability to SI scale
 - Provide agencies/organizations without necessary resource an opportunity to perform vicarious calibration for their sensors

Objectives

- Initial RadCalNet objectives
 - Define detailed architecture of RadCalNet
 - Demonstrate operational concept with currently available infrastructure and resources
 - Goal: Provide data to 'beta' users in fall 2016

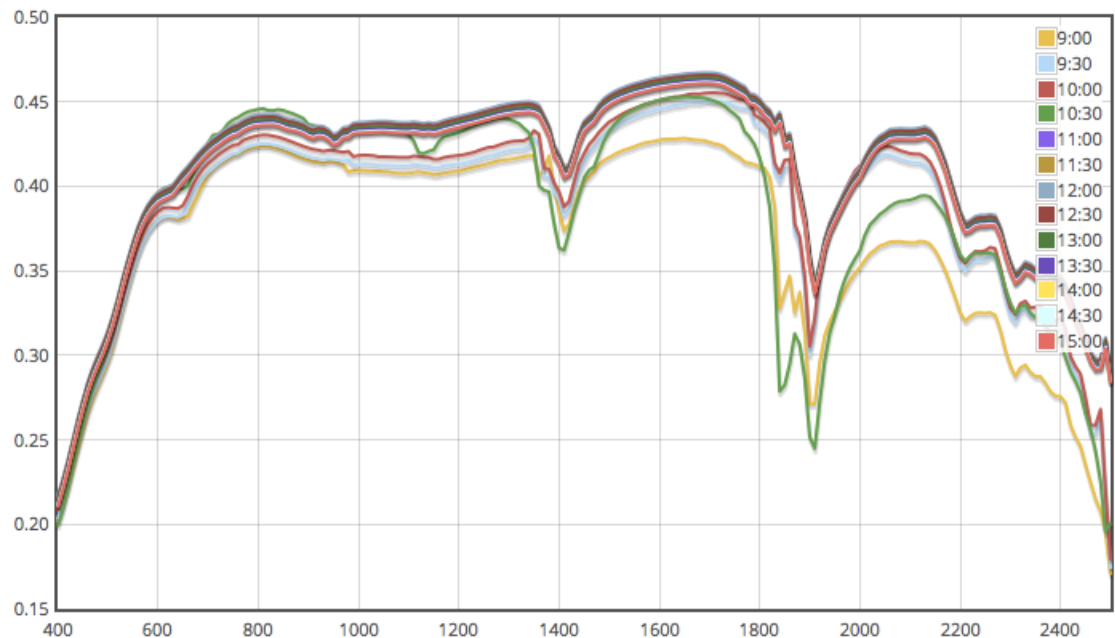
RadCalNet WG members at 3rd meeting (NPL, UK):

- AOE (China) (C. Li, L. Ma, L. Tang, N. Wang)
- CNES (P. Henry, A. Meygret)
- ESA (M. Bouvet, P. Goryl) supported by Magellium (B. Berthelot)
- NASA (K. Thome) and University of Arizona (J. Czapla-Myers)
- NPL (N. Fox, E. Woolliams)



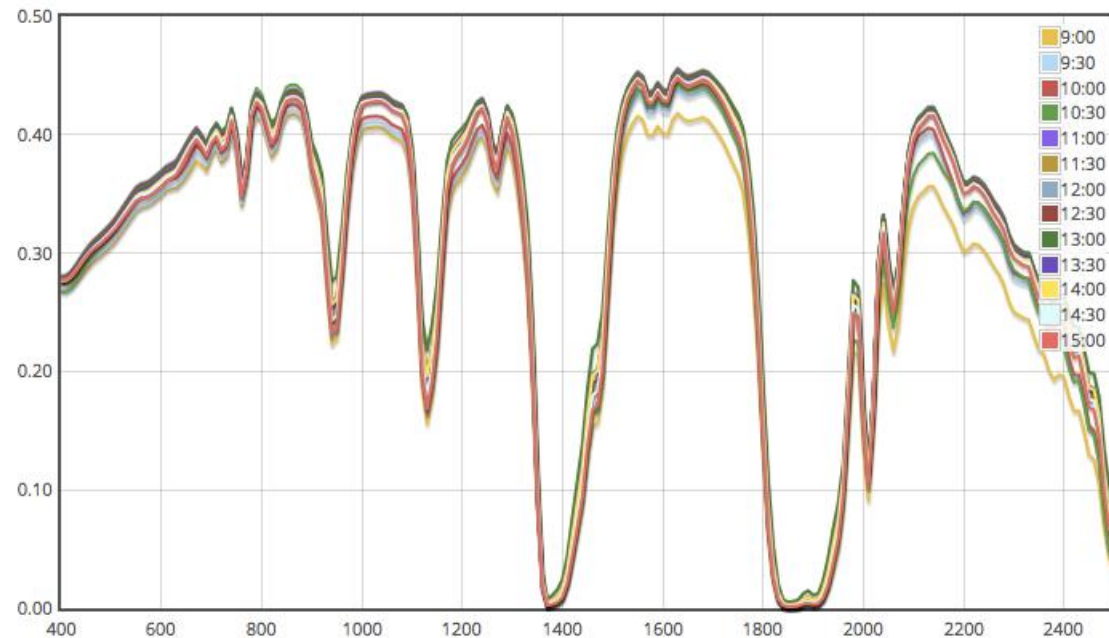
RadCalNet Input Data

- Surface Reflectance
 - 30 minute intervals
 - 9 am to 3 pm local standard time
 - Nadir view
 - 10 nm intervals from 400 nm to 2500 nm
- Atmospheric Data
 - Pressure
 - Temp
 - Aerosol
 - Water Vapor
 - Ozone
- Uncertainty

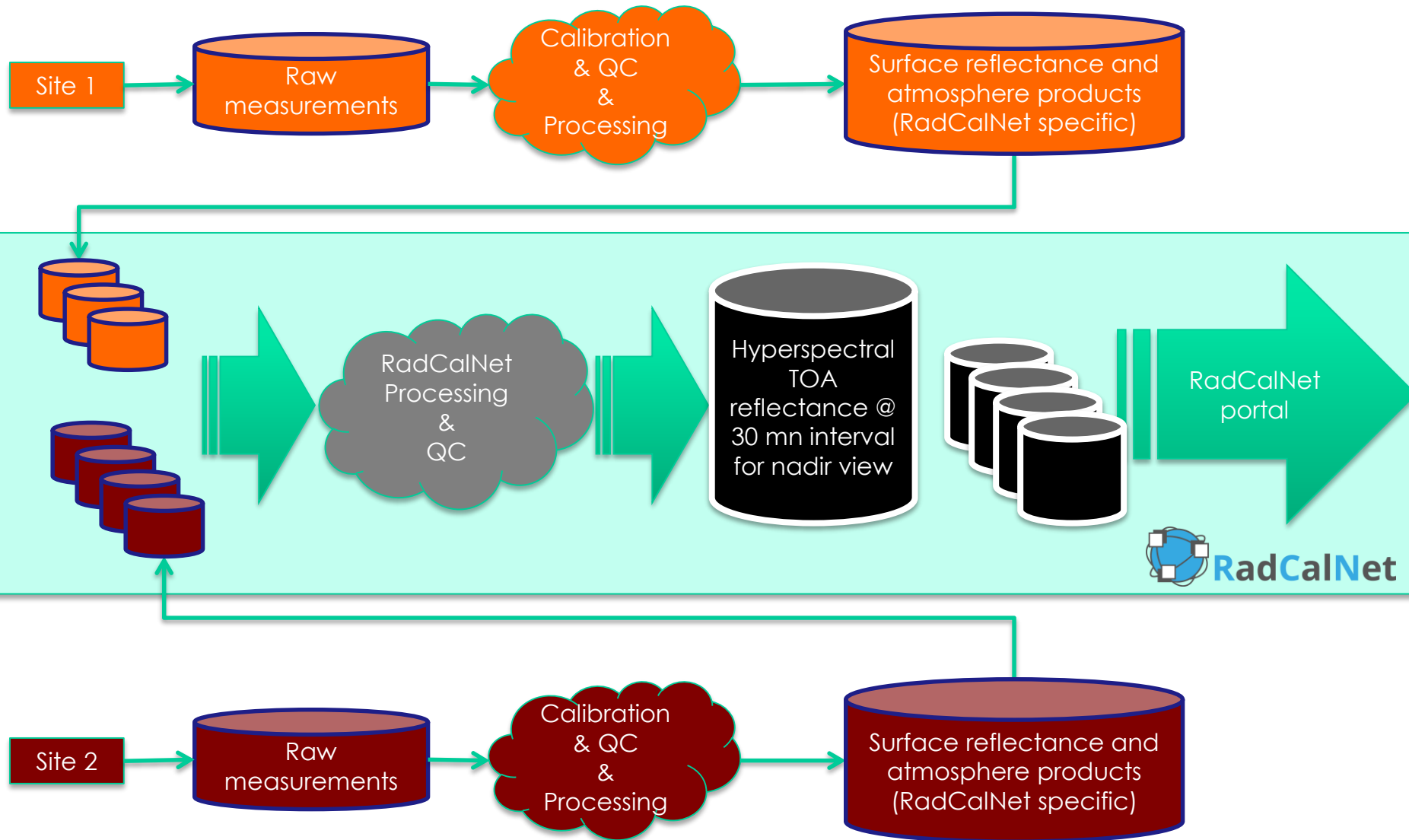


RadCalNet Output Data

- TOA Reflectance
 - 30 minute intervals
 - 9 am to 3 pm local standard time
 - Nadir view
 - 10 nm intervals from 400 nm to 2500 nm
- Uncertainty



RadCalNet Data Processing



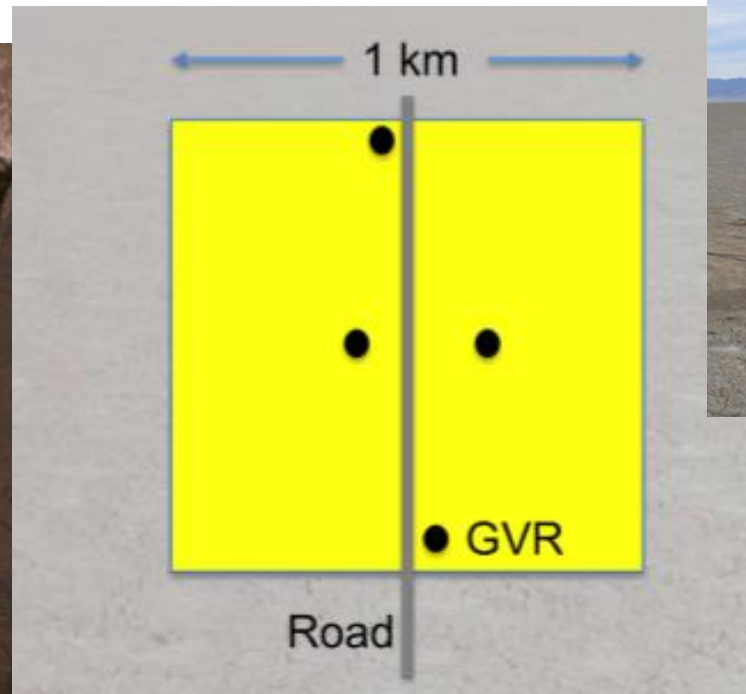
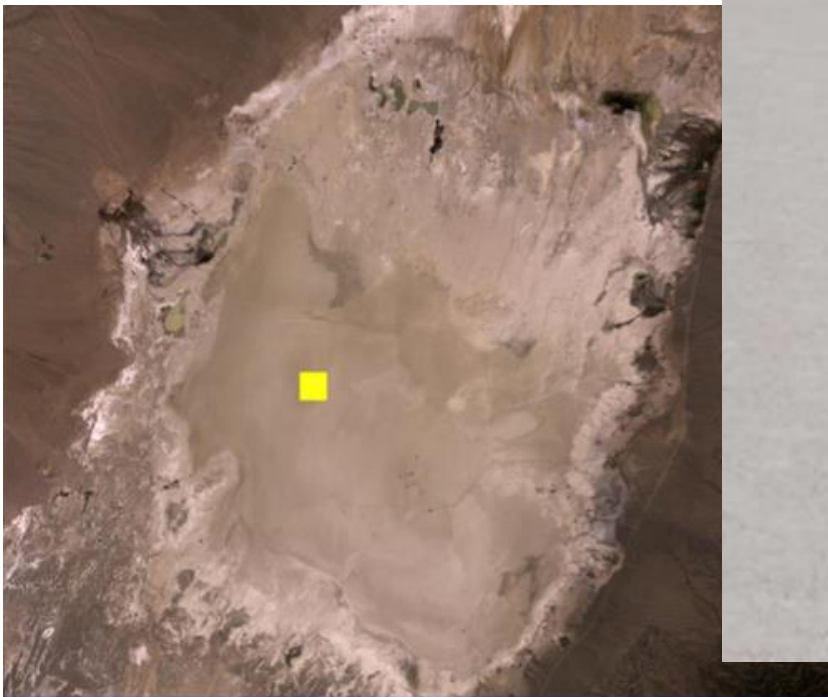
RadCalNet Sites

- Three sites proposed for initial demonstration of network
 - Railroad Valley Playa (RVUS) [NASA]
 - La Crau (LCFR) [CNES]
 - Baotou (BTCN) [AOE]
- Fourth site identified and in process of being instrumented
 - Gobabeb (GBNA) [NPL]



Railroad Valley Playa, US

- 4 radiometers (GVRs) + sun photometer + met station
- Surface type: dry lakebed
- U.Ariz. has 20+ years working experience on the site
- Site operational with data set via sat link



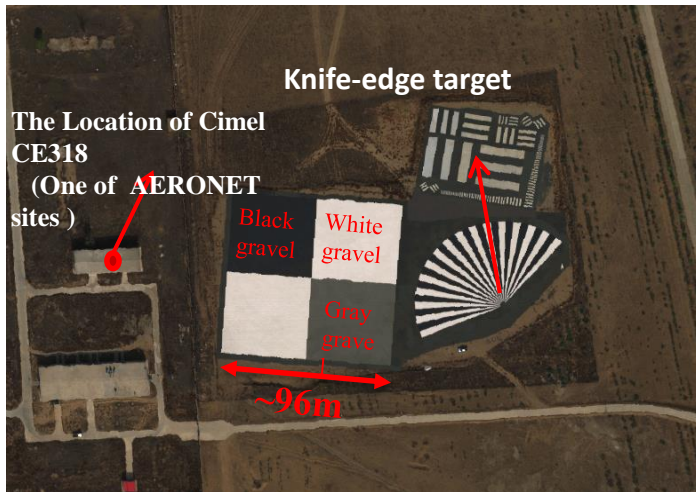
La Crau, France

- Instrument: CIMEL photometer (12 bands)
- Surface type: pebbles and low vegetation
- Site used since 1987 for calibration and instrumented since 1997.



Baotou, China

- Three automated reflectance spectrum measurement systems have been installed + sun photometer
- Artificial target (white, black, and gray)
- All the data from these three systems is being transferred directly to Beijing since Oct 25, 2015.



Aerial image acquired in Baotou site October 17, 2015



Stationary system in black and white targets



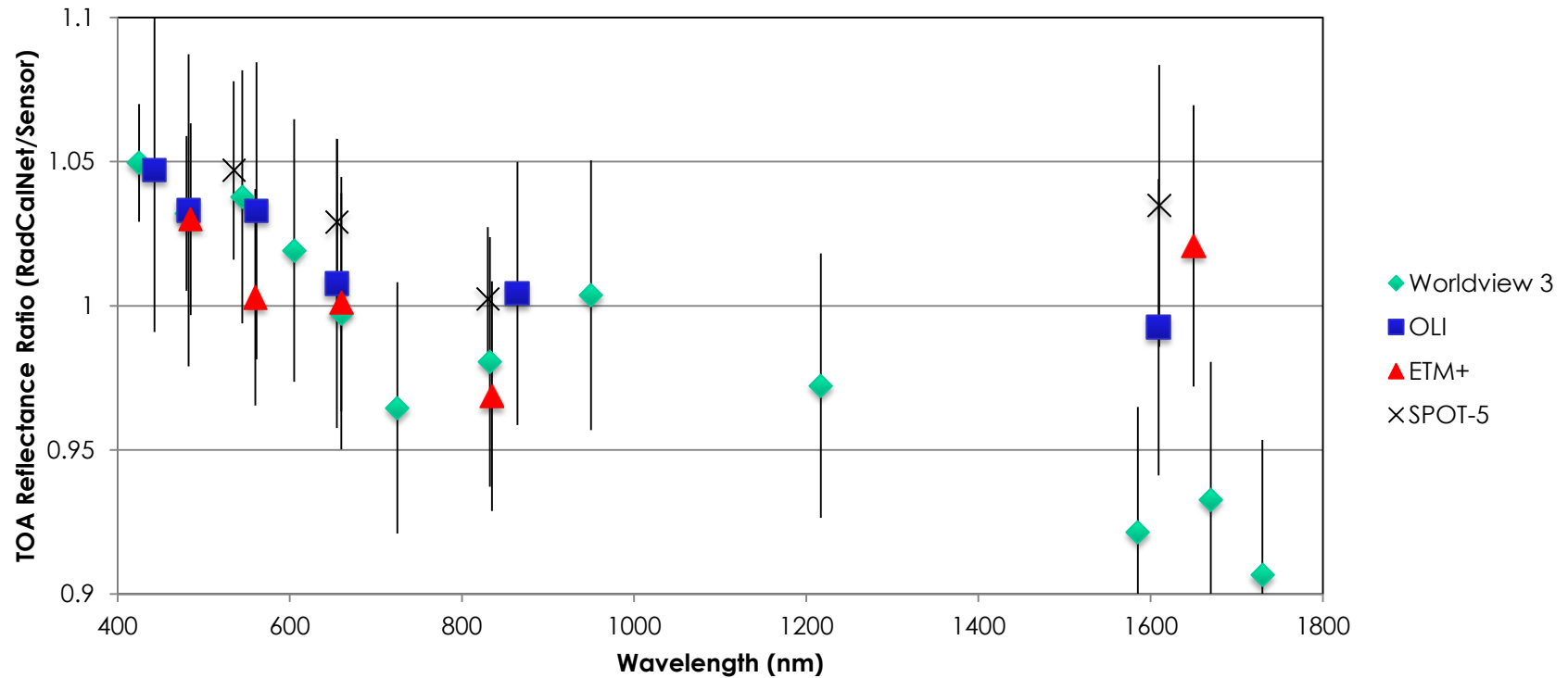
Rotatory system in gray target

Gobabeb, Namibia

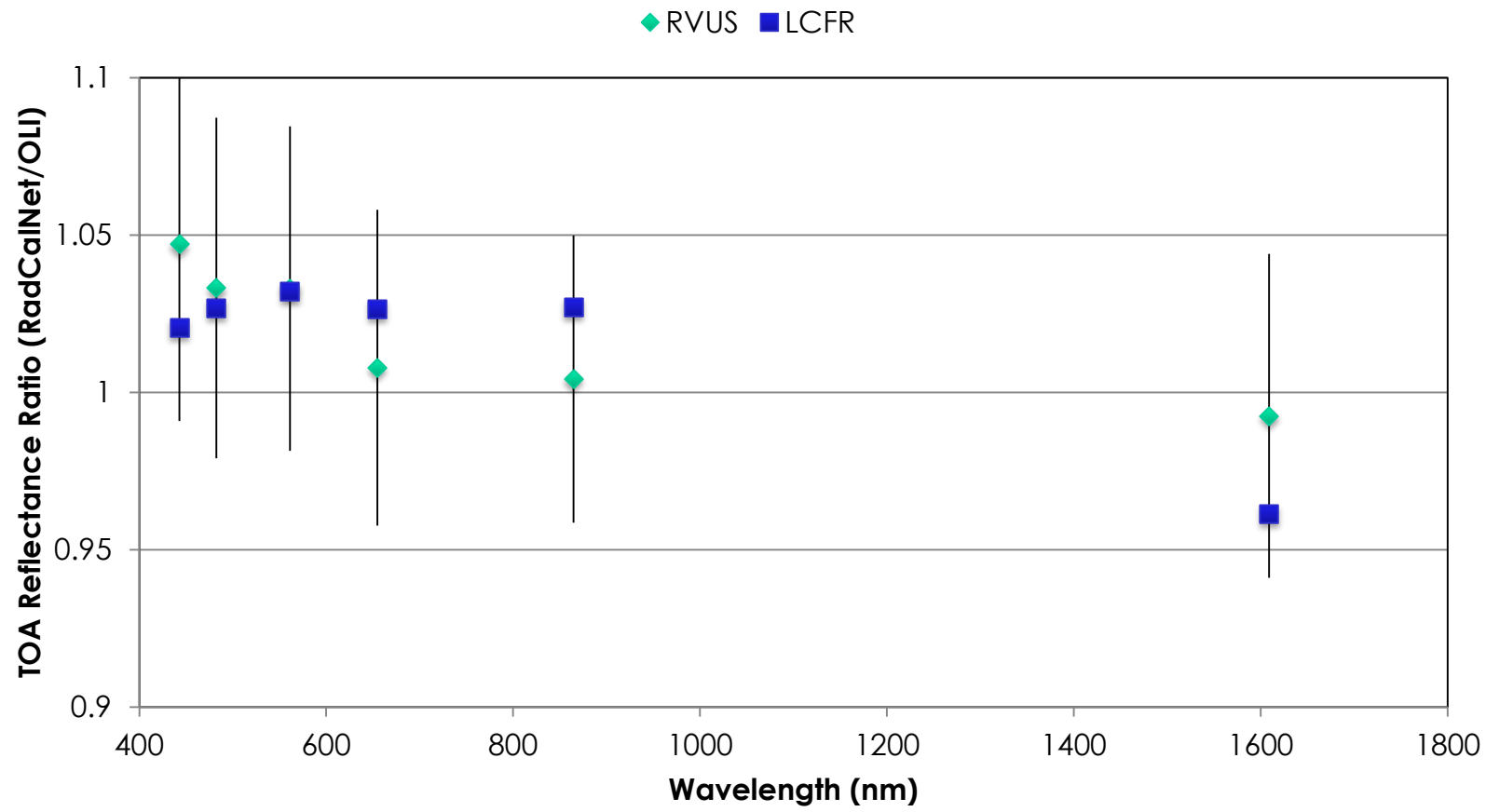
- Instrumentation: A photometer (model similar to La Crau) was purchased and fully characterised by NPL and met station
- Surface type: sparse dry grass and gravel/sand
- Mid-2016: install instrumentation at site



RadCalNet: Multiple Sensors at Single Site (RVUS)



RadCalNet: Single Sensor at Multiple Sites (OLI)



RadCalNet Data Policy

- Publically available on FTP site hosted by CNES
- Free
- Expected to open to beta users in mid-2016
- Expected to be operational in early 2017
- Users should acknowledge RadCalNet and site owners

RadCalNet Status

- Three sites operational (RVUS, LCFR, BTCN)
- Fourth site expected later this year (GBNA)
- Data processing algorithms complete and test datasets generated [NASA]
- Data archiving architecture in place and exercised [CNES/Magellium]
- In-progress
 - Uncertainty analysis/documentation
 - Define criteria for new site membership